Creativity Support for Designing Ubiquitous Computing Applications

Bettina Conradi
University of Munich
Amalienstr.17
Munich, Germany
bettina.conradi@ifi.lmu.de

Heinrich Hussmann
University of Munich
Amalienstr.17
Munich, Germany
heinrich.hussmann@ifi.lmu.de

ABSTRACT
Designing ubiquitous computing applications not only requires technical knowledge but also creativity. New ways of seamless interaction with computers and new applications domains that target real user needs have to be found. That demands collaboration between several disciplines such as product and interaction designers as well as software and hardware engineers. To let them collectively contribute to a creative idea new tools have to be elaborated that support the creative phases and serve as a framework for requirements that need to be considered in the ubiquitous computing domain. We want to present several attributes and requirements for such a tool.

Categories and Subject Descriptors
J.m [**Miscellaneous**]: Design, creativity, innovation.; K.4.3 [**Computers and Society**]: Organizational impacts - *computer-supported collaborative work*

General Terms
Design, Innovation

Keywords
Creativity, creativity tool-support, ubiquitous computing

1. MOTIVATION
Ubiquitous computing is an emerging field in computer science which assumes that computers are invading our everyday life more and more, "they weave themselves into the fabric of everyday life until they are indistinguishable from it"[4]. A huge challenge in ubiquitous computing is to design applications which are usable as well as useful, because the design and solution space for initiation and use of a service that is ubiquitous has broadened widely. New interaction techniques have to be developed by a variety of different disciplines: Product and interaction designers have to discover new ways of intuitive interaction of one person surrounded by several computers. Software and hardware engineers are concerned with building a product that makes use of a variety of new technologies (e.g. NFC, Bluetooth, Multitouch etc.). They have to contribute to the technical requirements and limitations of the future product and can also evaluate technical feasibility of a new concept. All these disciplines have to work together creatively to find an optimal solution. Tool-support can help in designing ubiquitous computing applications through *creative requirements engineering*. On the one hand it can provide an information space for creativity where every discipline can contribute to and where early requirements are elicited and ideas are generated and disseminated. On the other hand it can provide a framework for the specific requirements that need to be considered while designing a ubiquitous computing application (e.g. environmental conditions, technical limitations etc.). This leads to the following questions:

1. How can the different disciplines contribute to the early creative phases in one unifying process? Which phases need tool support and how could this look like?
2. What are the requirements and limitations that need to be taken special care of in the ubiquitous computing domain? How can tool support help in gathering and eliciting them?
3. What kind of creativity techniques exist that help in these early phases? Are there any built systems that support these techniques and how good do they work?

The remaining paper is structured as follows: First we want to define the creative process per se with the help of Shneiderman's genex framework for creativity [3] to see which phases exist in the creative process and what kind of tools could possibly help in these phases. Next we want to propose initial answers for our research questions and afterwards describe our ideas for future work in this domain.

2. PHASES IN THE CREATIVE PROCESS
In order to support the early creative design phases it is important to know what these phases constitute of and how they can be supported. Shneiderman [3] describes four creative phases: collect, relate, create and donate. We found out that these four phases give a very appropriate structure for the necessary components for a creativity supporting design process. Table 1 shows these *phases*, their *activities* and possible *features* that could help supporting them. The column *tools* is meant as a collection of related work and applications that could be integrated into a holistic *creative requirements engineering* support tool. Examples for useful

Table 1: Phases in the Creative Process

Phase	Activities	Features	Tools
collect	Collection of material that is related to the problem domain	easy sharing of material, provide a framework for requirements that need to be considered (e.g. personas, environmental conditions, technical limitations)	specialized search tools (e.g. combinFormation[2]), wikis, media collections
relate	Discussing the material with peers and mentors	support viewing and sorting of the material	interactive large displays, portfolio walls [1]
create	Brainstorming about possible solutions	support brainstorming capture decision process	brainstorming tools, random presentation of collected material and requirements
donate	disseminating results	support in justifying an idea through reference to initial findings, support formulating of structured requirements for development	tracing to results of earlier phases, templates

tools include the combinFormation-project [2], that allows multiple users to create a collage of related work with agent's support in the collect-phase, or Bill Buxton's portfolio wall [1], that was used in the automotive design industry to share design ideas and sketches on a large interactive display in the relate-phase.

3. REQUIREMENTS FOR A CREATIVITY TOOL SUPPORT

Summarizing the insights from the analysis of Shneiderman's creativity framework we have already found answers to our research questions and inital requirements for our tool:

1. Different disciplines need different tools to support very creative as well as very structured work. Our tool should support the four creative phases *collect*, *relate*, *create* and *donate* and thus capture the early design process and hinder information gaps. It should also allow easy switching between all phases in order to not restrict creativity. It should provide information spaces that suit the different working styles of involved disciplines (e.g. brainstorming tools, diagrams, forms, modeling and simulation tools). But it should not only provide a separated space for every discipline, but a space where requirements and ideas can be related in collaboration in order to find an optimal solution (e.g. collaboration and communication tools, such as instant messaging, forums, online meeting etc.)

2. After reviewing several projects and creatively exploring new topics, we have found out that there are reoccurring patterns of requirements which are very important to consider in the early design phases. As already mentioned it is necessary to explore the environment (e.g. noise level, location etc.) and technical limitations (e.g. technology used, available sensors or networks) as well as special user characteristics (e.g. current activity, expected usage time etc.). A tool should provide a framework for requirements that need to be taken care of when designing a ubiquitous computing application and guide the user in remembering all important aspects.

3. The tool should integrate known tools such as brainstorming software, pinboards for collecting material and many more of the before mentioned tools or support easy exchange with them. Furthermore, it should support not only desktop use but also ubiquitous computing tools to enhance a co-located or distributed creativity process.

4. CONCLUSIONS AND FUTURE WORK

To summarize there are good reasons for creativity tool support in ubiquitous computing:

- Product and interaction designers can profit from a unifying tool that supports the early creative design. phases
- Software and hardware engineers can contribute to and comprehend the requirements, limitations and design decisions that lead to the final concept
- All disciplines can profit from detailled guidelines for requirements that need to be taken into account while analyzing a problem and finding possible solutions.

Our future work includes on the one hand the development of a holistic creativity support tool that lets users collectively contribute to a shared idea in all creative phases from collecting related work to creating new ideas and disseminating the results. On the other hand we want to extract common patterns of requirements for ubiquitous computing in an iterative manner. Finally both approaches should be integrated in one tool, that guides the user in the creative phases and provides a framework for needed material.

5. REFERENCES

[1] W. Buxton, G. Fitzmaurice, R. Balakrishnan, and G. Kurtenbach. Large displays in automotive design. *IEEE Computer Graphics and Applications*, 2000.

[2] A. Kerne, E. Koh, S. M. Smith, A. Webb, and B. Dworaczyk. combinformation: Mixed-initiative composition of image and text surrogates promotes information discovery. *ACM Trans. Inf. Syst.*, 2008.

[3] B. Shneiderman. Creativity support tools: accelerating discovery and innovation. *Commun. ACM*, 2007.

[4] M. Weiser. The computer for the 21st century. *Scientific American*, (Communications, Computers, and Network), September 1991.